Tsunehiko NISHIKAWA* & Koji ITO**: **New chromosome numbers of *Adonis amurensis* Regel et Radde of Hokkaido*****

西川恒彦*・伊藤浩司**: 北海道産フクジュソウの新染色体数***

The chromosome numbers of "Fukujyuso" (*Adonis amurensis* Regel et Radde) reported from Japan are n=12 (Takamine 1916, under the name of *A. davurica*), n=20 (Sugiura 1931, under the name of *A. vernalis* var. *amurensis*), and 2n=24 (Kurita 1955). In our recent studies on *A. amurensis* of Hokkaido, Nishikawa, one of the authors, proved two sorts of somatic chromosome numbers, 2n=16 and 2n=32. In the present paper, the authors tried to examine some outermorphological characters in relation to the chromosome numbers.

Materials and Methods

Living plants were collected from 25 localities in Hokkaido as shown in Fig. 1, and transplanted at Asahigawa. For the determination of somatic chromosome numbers the ovules were employed. They were fixed in a 3:1 mixture of alcohol and acetic acid for 5 minutes, and then transferred to 1*N* HCl at 60°C for 4 minutes. The chromosome number was determined in the ordinary squash preparations stained with acetic orcein.

Herbarium specimens deposited in SAPT were used for outermorphological observations. They are invaluable materials, particularly in order to discover the geographical range as well as morphological variations in Sakhalin plants.

Observations

1. Somatic chromosome number: As shown in Fig. 2, two kinds of somatic chromosome numbers were proved; one is 2n=16, and the other is

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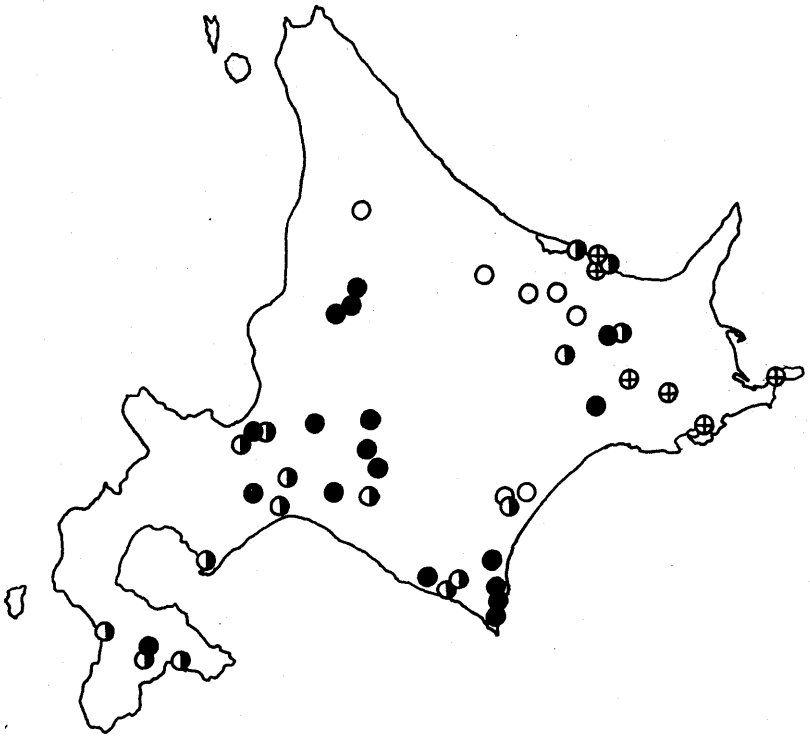

Fig. 1. Distribution map of *Adonis amurensis* with 2n=16 and 2n=32 in Hokkaido. Open circles: 2n=16 plants based on the chromosome observation. Solid circles: 2n=32 plants based on the chromosome observation. Circles with cross: 2n=16 plants based on herbarium specimens. Half solid circles: 2n=32 plants based on herbarium specimens.

2n=32. The former number was found in plants collected from the following localities; Nayoro, Maruseppu, Rubeshibe, Tsubetsu, Kitami and Atsunai. These localities are situated in Northern and Eastern Hokkaido. The latter number was found in plants collected from the following; Hakodate, Sapporo, Shikotsu, Kuriyama, Kanayama, Shimekappu, Kamuikotan, Asahigawa, Azuma, Hidaka, Urakawa, Meguro, Shoya, Hiroo, Tsurui and Kuttyaro. As shown by the present data, plants with 2n=32 chromosomes seem to weigh its distribution range rather in Central and Southern Hokkaido, although a few extend as far as North-Eastern Hokkaido.

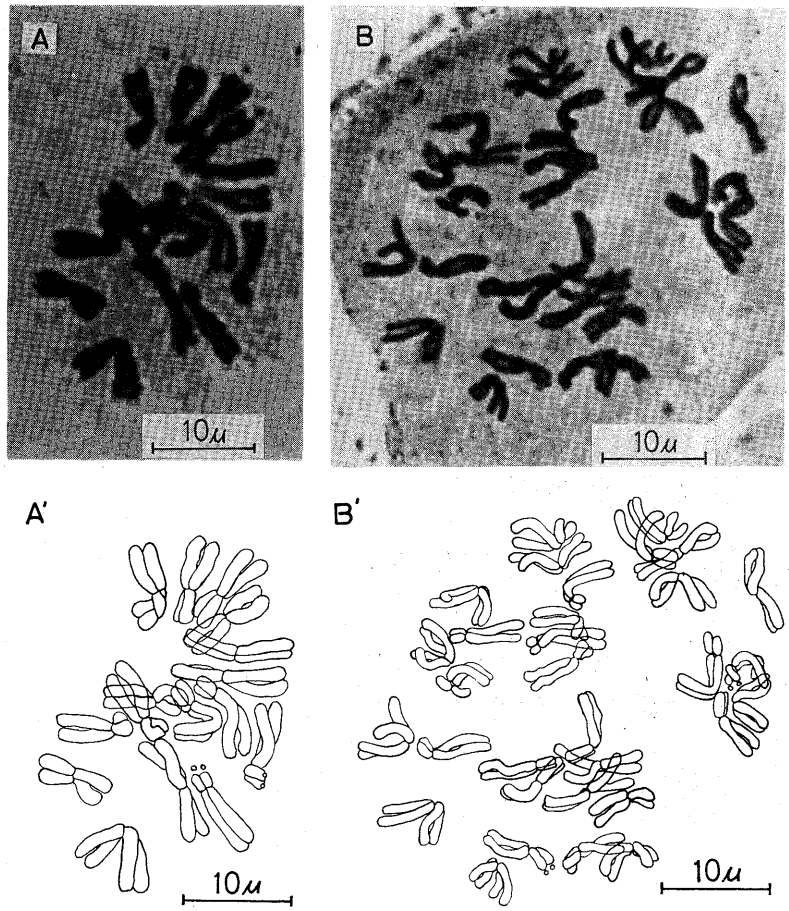

Fig. 2. Somatic chromosomes of *A. amurensis* (photo by T. Nishikawa). A & A': Somatic chromosome showing 2n=16 (Rubeshibe, Kitami Prefecture). B & B': Somatic chromosome showing 2n=32 (Hyakuninhama, Hidaka Prefecture).

2. Size of leaf and stoma: The present character was compared between 2n=16 plants and 2n=32 plants. As a result, it is proved that both leaf size and stoma size is larger in 2n=32 plants than 2n=16 plants, as shown in Figs. 3 and 4. It is noted in Fig. 4 that 2n=16 plant has four stomata in a definite area but 2n=32 plant has two stomata in the same area.

3. Hairiness of leaf: In both plants, the adaxial side of the leaf is

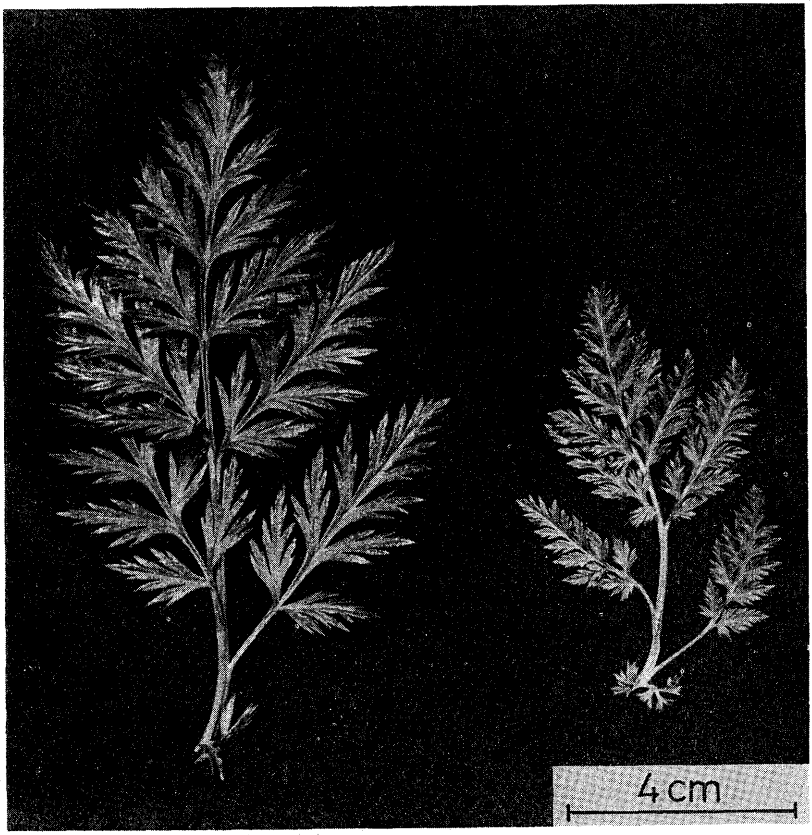

Fig. 3. Leaves of *A. amurensis*. Left: a leaf of 2n=32 plant (Hyakuninhama). Right: a leaf of 2n=16 plant (Kitami Wakamatsu).

scatteringly hairy or scarcely hairy, or glabrous. The abaxial side of the leaf is hardly hairy in 2n=32 plants but it is moderately to densely hairy in 2n=16 plants. This difference is shown in Fig. 5.

4. Flower number per stem: One hundred and fifty one living plants were used to investigate flower numbers borne on a stem. As shown in Table 1, about 95% of the total plants investigated bore a single flower. All the 2n=16 plants bore a single flower, while the plants with two or more flowers were always 2n=32. The 2n=32 plants however did not always have two or more flowers.

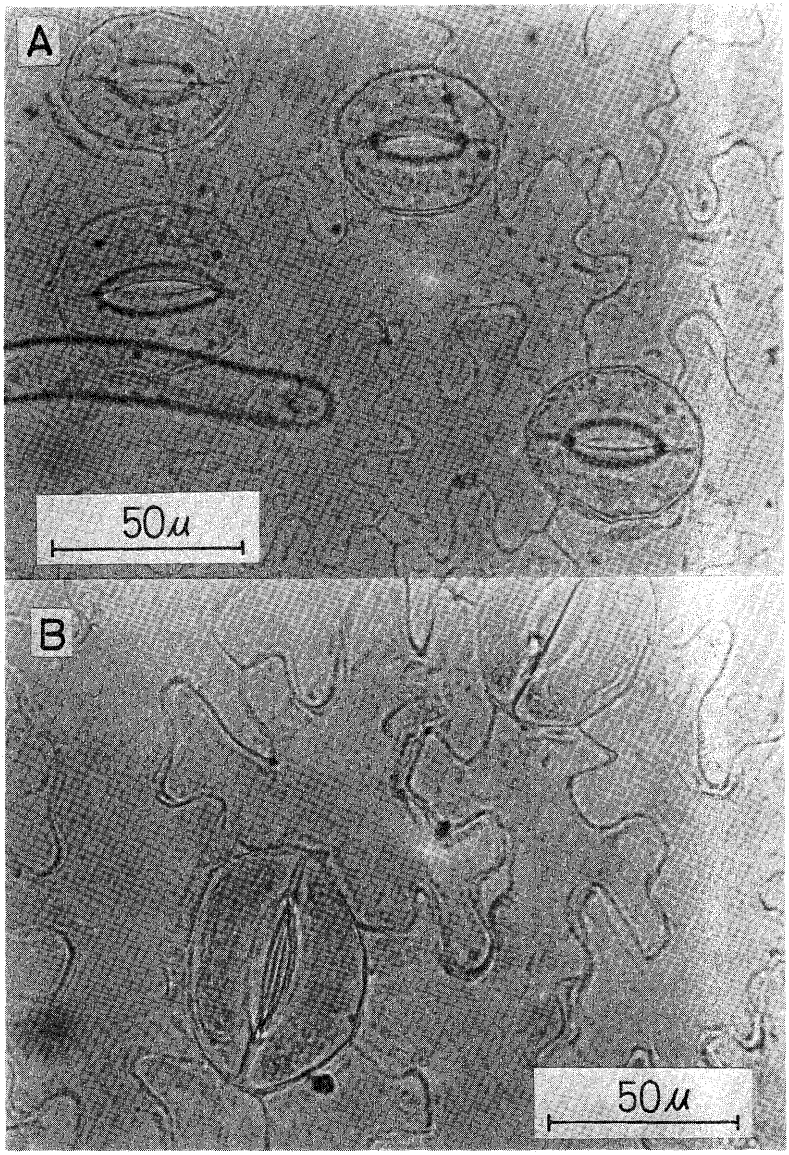

Fig. 4. Epidermis cells and stomata of *A. amurensis*. A: 2n=16 plant (Kitami Wakamatsu). B: 2n=32 plant (Hyakuninhama).

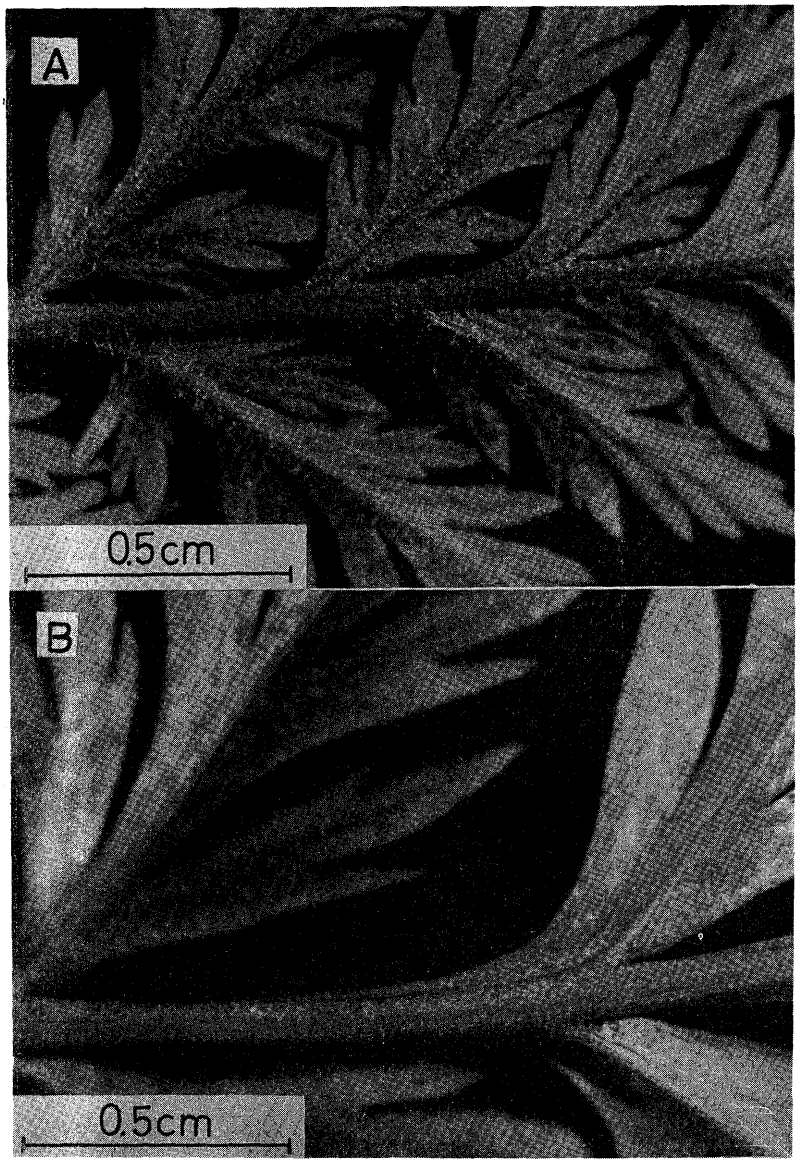

Fig. 5. Hairiness of abaxial surface of leaf. A: 2n=16 plant (Kitami Wakamatsu). B: 2n=32 plant (Hyakuninhama)

Table 1. Flower number per stem of *Adonis amurensis* in Hokkaido.

Items	No. of plants	2n=
One flower	144	16, or 32
Two flowers	4	32
Three flowers	2	32
Four flowers	1	32
Total	151	

5. The ratio of sepal length to petal length: According to Gorovoy and Gurzenkov (1969), the ratio of sepal length (S) to petal length (P) seems to be one of the characters to separate Japanese Fukujyuso from continental *Adonis amurensis*. This character was estimated by a numerical point method. Points used in this study are as follows: -1: S<P (the difference is more than 1 mm long), -0.5: S≦P or S$\underset{\cdot}{\leqq}$P, 0: S=P or S$\underset{\cdot}{=}$P, $+0.5$: S$\underset{\cdot}{\geqq}$P or S≧P and $+1$: S>P.

From Table 2, in nearly all the materials used the sepals are equal to the petal length or a little shorter. As far as the ratio is concerned, there is no difference between 2n=16 plants and 2n=32 plants.

6. Achenes: No clear differences between 2n=16 plants and 2n=32 plants were observed in the size and shape of achenes. All the achenes were covered densely with short hairs, and hairiness is independent upon somatic chromosome numbers. Gorovoy and Gurzenkov (1969) pointed out that in *A. amurensis* the styles are considerably bent from the base and appressed tightly on the surface of achenes. Generally speaking, styles of 2n=32 plants inclined to be more bent and appressed as seen in Fig. 6, in which the left is a mature fruit of the plant collected at Hyakuninhama (2n=32) and the right is that of the plant at Kitami Wakamatsu (2n=16).

Conclusion

A polysomatic series of chromosome numbers is not unusual in Ranunculaceae (Langlet 1927). In the genus *Adonis*, Langlet (1927) reported n=8, 12 and 16. At present, in Japanese and Far Eastern *A. amurensis* (s.l.) n=12 (Takamine 1916, Ishikawa 1916), n=20 (Sugiura 1931), 2n=24 (Kurita 1955), and 2n=16 (Sokolovskaya 1966, according to Gorovoy et al. 1969) are

Table 2. Numerical points of the ratio of sepal length to petal length.

Localities	2n	Points*
Atsunai	16	0
Kitami Wakamatsu a	16	0
〃 〃 b	16	−0.5
Maruseppu	16	−0.5
Nayoro	16	0
Rubeshibe	16	−0.5
Tsubetsu	16	+0.5
Urahoro a	16	0
〃 b	16	−0.5
Azuma a	32	+1.0
〃 b	32	−0.5
Hakodate	32	0
Asahigawa Arashiyama a	32	0
〃 〃 b	32	−1.0
Hiroo	32	0
Hyakuninhama a, b, & d	32	0
〃 c	32	−1.0
Kamuikotan	32	−0.5
Kanayama	32	−1.0
Kuriyama a	32	0
〃 b	32	−1.0
Kuttyaro a & b	32	0
Shikotsu a	32	0
〃 b	32	−0.5
Shimekappu	32	0
Tsurui a	32	0
〃 b	32	−0.5
Urakawa a	32	0
〃 b	32	−0.5

* Points, see text.

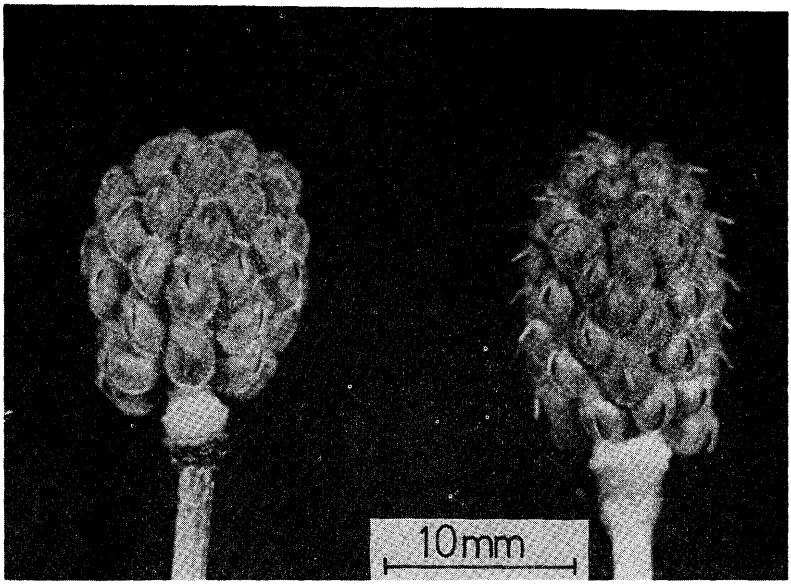

Fig. 6. Achenes of *A. amurensis*. Left: 2n=32 plant (Hyakuninhama). Right: 2n=16 plant (Kitami Wakamatsu).

recognized. In the present study, the authors proved two chromosome numbers, 2n=16 and 2n=32.

As the basic number of *Adonis* is believed to be x=8, *Adonis* plants investigated are diploid and tetraploid respectively. These chromosome numbers are not contradictory to the polysomatic series of *Adonis* chromosome numbers (n=8, 12, 16, etc.)

Based upon the outermorphological characters, the authors made an attempt to distinguish 2n=16 specimens from 2n=32 specimens in herbarium specimens preserved in SAPT. Occurrences of these possible cytologically different sorts of specimens were dotted as seen in Fig. 1. Thus, it may be said that 2n=32 plants occupy mainly Central, Southern, and South-Western Hokkaido, and that 2n=16 plants range along the Ochotsk Sea side to the Pacific Ocean side of Eastern Hokkaido. This means that 2n=16 plants are distributed in the North-Eastern part of Hokkaido. It is interesting that at a few localities in the district of Kitami, Kushiro and Tokachi both 2n=16 plants and 2n=32 plants are found together.

The most conspicuous contrast between 2n=16 plants and 2n=32 plants in the outermorphological characters observed is shown in the size of leaf and stoma, and hairiness of leaf. As it is a well-known cytological fact that leaves, epidermis cells, stomata, etc. increase in size or dimension in polyploid plants, it is, therefore, very natural that 2n=32 plants should have a larger size of leaf and stoma than that of 2n=16 plants. As far as Hokkaido "Fukujyuso" is concerned, densely hairy plants are related to 2n =16 plants, and in this case, hairiness seems to be not correlated with the polyploidy.

Recently Gorovoy and Gurzenkov published a new paper on the Far Eastern species of *Adonis* (Gorovoy and Gurzenkov 1969, Kitagawa 1971). It is their opinion that the Japanese Fukujyuso is distinctly different from the Far Eastern *Adonis amurensis* Regel et Radde not only in morphological characters but also in chromosome number. According to them, the chromosome number of Japanese Fukujyuso is n=12 and that of the Far Eastern *A. amurensis* is n=8, and the correct name for the Japanese Fukujyuso is *A. ramosa* Franchet. Kitagawa (1971) accepted this opinion and called *A. ramosa* "Edauchi-Fukujyuso".

In the present study, the authors wonder if the Far Eastern *A. amurensis* should be distinguished clearly from the Japanese *A. ramosa*, and they think that further studies are neccessary to revise the Far Eastern *Adonis* species.

However, it should be noted that *A. amurensis* var. *yezoensis* Kudo in 1922 (nom. nud.) surely coincides with *A. ramosa*, and that *A. amurensis* var. *puberula* Honda or "Kitami-Fukujyuso" is our 2n=16 plant itself. Honda's variety is distributed in Sakhalin and North-Eastern Hokkaido.

Literature cited

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北海道産フクジュソウについて，胚珠を用いて染色体数を観察した。この結果，北海道産フクジュソウの染色体数には，2n=16 と 2n=32 の2種類の数があることがわかった。更に 2n=16 のフクジュソウと 2n=32 のフクジュソウは，地理的分布を異にする。前者は，道北及び道東すなわちオホーツク側から太平洋側，十勝，釧路，根室地方にかけて主に分布し，後者は，残りの中央及び南西北海道に分布する他，少数のものが，太平洋沿いに，十勝そして釧路地方の内部まで及んでいる。

染色体数の異なるフクジュソウについて，次の外部形態的特徴，すなわち，1) 葉，気孔，及び表皮細胞の大きさ，2) 葉の毛の程度，3) 茎当りの着花数，4) 萼片の長さと花弁の長さの比，及び 5) 果時の花柱の湾曲度について調べた。その結果，2n=16 植物と，2n=32 植物の間にあらわれた最も顕著な差は，1) と 2) である。1) では 2n=32 植物が，いずれも，2n=16 植物より大きい。このことは，一般に倍数性を示す同種間の植物の間にみられる関係と一致する。2) では，2n=16 植物は，葉の下面に密に毛を生ずるが，2n=32 植物は，無毛または，それに近い。

これまで，我国のフクジュソウの染色体数は，n=12, n=20, 2n=24 と報告されているが，Gorovoy らによれば，大陸のフクジュソウ (=*A. amurensis*) は 2n=16 であるという。染色体数から判断すれば，北海道産のフクジュソウは大陸の *A. amurensis* 型で，Gorovoy らが分けた日本のフクジュソウ (=*A. ramosa* Franch.) と異なる様であるが，著者らはこの区分にまだ確信をもっていない。

最後に著者らは1922年，工藤博士の北海道薬用植物図彙に載っている *A. amurensis* var. *yezoensis* Kudo は，いわゆる，*A. ramosa* Franch. に相当し，本田博士の *A. amurensis* var. *puberula* Honda (キタミフクジュソウ) は，本研究で区別された 2n=16 のフクジュソウそのものであると結論した。

本報告をまとめるに際し，有益な助言と教示を与えられた原寛先生に，心から御礼申し上げます。

□Helmut Bechtel: **Orchideen** 180pp. 内 22–179 が plates. Bertelsmann Lexikon Verlag (Berlin), ¥12,800, (1977). ドイツで出版されたランの花の写真集。全体をアメリカ熱帯圏，アフリカ熱帯圏，インド一濠州熱帯圏としてまとめて，美しい花，変つた花など，大体75属を展開したものである。何しろ大きいのは 24 cm 一杯の図面に拡げてあり，撮影と印刷が共によいので，細かな蕊柱の曲り方や光り方などもよく分かるのがよい。適当な長さの記事も少しついている。*Masdevallia attenuata*, *Bonatea antennifera*, *Paphiopedilum randsii*, *Mediocalcar erectum*, ニオイラン (台湾) など見慣れぬ姿もあって楽しい。 (前川文夫)